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ABSTRACT

All institutions face the deterioration of works of art on paper. This latest volume in the Occasional Papers series is a practical guide for professionals needing to store and preserve works of art on paper. The author--Head of Conservation at the Minnesota Historical Society who has 28 years' experience as a practicing conservator, consultant, and teacher--makes the case that preventative care is a realistic goal and is easily accomplished and relatively inexpensive. She details the considerations of choosing proper storage locations and enclosures, and notes that following these guidelines is a practical, cost-effective way to contribute to the preservation of works of art on paper. Highlights of the discussion include: selecting storage locations; selecting storage enclosures; standard-sized enclosures; types of enclosures; selecting storage furniture; types of storage furniture; oversized storage; and routine handling. (Contains 25 references.) (AEF)

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A Basic Guide for Institutions

By
Sherelyn Ogden

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The Storage of Art on Paper

A Basic Guide for Institutions

INTRODUCTION

Because paper is a relatively fragile material, works of art on paper are particularly vulnerable to the damaging effects of poor storage. Careless, haphazard, and overcrowded conditions cause buckling, creasing, abrasion, and soiling from surface dirt and other unnecessary damage. Poor-quality storage enclosures and furniture accelerate the chemical deterioration of paper. When items are being transported to and from storage or are being viewed, improper handling often leads to folds, tears, and fingerprints that can permanently disfigure works of art. It is easy to avoid these hazards by following a few basic guidelines. These include selecting storage enclosures of suitable quality, using the most appropriate types of enclosures and furniture, and observing sound handling practices, all of which will provide protection for even the most fragile artworks and will substantially extend their longevity. Perhaps the first consideration regarding the safe storage of art on paper, however, should be the location and features of the storage space.

SELECTING STORAGE LOCATIONS

The ideal storage space is one that is separate from all other activities, such as exhibition, preparation, study, and administration but is also relatively accessible to them. Works of art are at great risk of being damaged if they must be moved long distances, up and down stairs, or from one building to another in order to be used. Moreover, storing items at a distance from the people who use them most is, at the least, an inconvenience. The storage space should be large enough to avoid overcrowding and should provide a setting in which items can be safely removed from shelves or drawers and then easily returned. This is a special concern for oversized or stacked items. The setting also should offer adequate room for the growth of the collection. It should be well-ventilated and easy to keep clean, which requires a dust- and dirt-free area with furniture, wall, and floor surfaces that

are smooth and easily cleanable. Attics, basements, and locations that are near sources of pollution, such as parking garages or loading docks, should be avoided.

Temperature and Relative Humidity

Controlling the temperature and relative humidity in a storage space is of critical importance, for inappropriate levels of these promote the deterioration of works of art on paper. High heat and relative humidity accelerate the rate of deterioration and encourage mold growth and insect activity. Extremely low relative humidity, which can occur in winter in centrally heated buildings, may lead to desiccation and embrittlement of certain components of works of art.

Fluctuations in temperature and relative humidity are also damaging, and before climate control equipment is selected and installed, the guidance of an experienced climate control engineer should be sought. Paper is hygroscopic, readily absorbing and releasing moisture. It responds to diurnal and seasonal changes in temperature and relative humidity by expanding and contracting. These dimensional changes accelerate deterioration and can lead to such visible damage as cockling of the paper and flaking or fracturing of the media.

The ideal storage space should have climate controls that are capable of maintaining generally accepted preservation standards which considerably retard the deterioration of art works. A frequent recommendation is a stable temperature no higher than 70° F and a stable relative humidity between a minimum of 30% and a maximum of 50%. Research indicates that relative humidities at the lower end of this range are preferable since deterioration then progresses at a slower rate. In general, the lower the temperature the better. For this reason, the temperature recommendations for areas used exclusively for storage are lower than those for combination user and storage areas. Cold storage with controlled humidity is sometimes advisable for storage containing certain types of infrequently used works of art, such as some photographic materials. When these art works are taken out of cold storage, however, the radical rapid temperature changes they experience may cause condensation on them. In such cases, gradual acclimation is required.

Additional measures can be taken to control temperature and relative humidity. The buildings in which works of art are stored should be well maintained. Cracks should be sealed as soon as they occur. Doors and windows should be treated with weatherstripping and should be kept

closed to prevent the exchange of unconditioned outside air. In regions that experience cold winter weather, the windows can be sealed on the inside with plastic sheets and tape or, more securely, with both wallboard and plastic.

Light

Light accelerates the deterioration of paper by acting as a catalyst in its oxidation. It leads to weakening and embrittlement of cellulose fibers and can cause paper to bleach, yellow, or darken. Light also causes media and dyes to fade or change in color, altering the appearance of works of art. For these reasons, any exposure to light, even for a brief time, is damaging, and the damage is cumulative and irreversible.

Although all wavelengths of light are damaging, ultraviolet (UV) radiation is especially harmful to paper. Because of the high amounts of UV energy they emit, some of the most damaging sources of light are the sun, tungsten-halogen or quartz lamps, mercury or metal halide high-intensity discharge lamps, and fluorescent lamps.

As total damage is a function of both intensity and duration of exposure, illumination should be kept as low as possible and used for the briefest amount of time feasible. Ideally, art works should be exposed to light only while they are on display or being studied. At all other times, they should be stored in a light-tight container or in a windowless room illuminated only when the art works are being retrieved or replaced or when the room is being cleaned. Light levels there should be kept as low as possible and still enable location of art works and cleaning of the room, and exposure should be for the shortest time that is feasible. For many years, generally accepted recommendations limited visible light levels for works on paper to fifty lux (approximately five footcandles). In recent years, these recommendations have been debated, with aesthetic concerns and varying rates of light fading for different media being considered. Illumination should be by incandescent bulbs. It is important to note that these bulbs generate heat and should be kept at a distance from works of art. All light sources should be filtered to remove UV radiation. In general, if a light source emits more than ten microwatts per lumen, it requires a filter.

Ideally, storage rooms should be windowless. If they contain windows, these should be covered by drapes, shades, blinds, or shutters that completely block the sun. This will also aid in temperature control by minimizing heat loss and limiting the generation of heat by sunlight during the day. Skylights that allow direct sunlight to shine directly on works of art should either be covered to block the sun or be painted with titanium dioxide or

zinc white pigments, which reflect light and absorb UV radiation. Filters made of special plastics also help control UV radiation. Ultraviolet-filtering plastic films or UV-filtering polymethylmethacrylate can be used for windows to lower the amount of UV radiation passing through them. Because these filters do not provide 100% protection against light damage, drapes, shades, blinds, or shutters that completely block the light are preferable. Fluorescent tubes should be covered with ultraviolet-filtering sleeves. An alternative is the use of special low-UV fluorescent tubes. To help limit the duration of exposure of materials, timed switches should be used routinely in storage rooms.

Air Quality

Pollutants contribute heavily to the deterioration of works of art on paper. The two major types of pollutants are gases and particulates: gaseous contaminants catalyze harmful chemical reactions that lead to the formation of acid in paper, while particulates abrade, soil, and disfigure works of art. Controlling the air quality in storage spaces is a difficult and complex matter that depends on several inter-related factors. Various standards for air quality have been suggested, but until greater experience is gained, the most reasonable recommendation is that the amount of pollutants in the air be reduced as much as practicable.

The equipment available to improve air quality in storage spaces varies in size, complexity, and effectiveness. It should be selected to best address the particular level of pollution in the area where the storage space is located, and an experienced environmental engineer should be consulted for recommendations.

Several additional measures can help to control air quality. One is to provide good air exchange in areas where collections are stored, with replacement air being as clean as possible. Air intake vents should be located as far as possible from sources of heavy pollution, such as a loading dock where trucks idle. Other measures include keeping exterior windows closed and storing works of art in enclosures, which may help decrease the effects of pollutants. Enclosures that contain molecular traps such as activated carbon or zeolites appear to be particularly effective in this regard. To the extent that it is possible, the origins of pollution should be eliminated from inside or near the storage space. While automobiles and industry—major sources of pollution—will probably be beyond control, other sources may be reduced. These include cigarette smoke, photocopying machines, certain types of construction materials, paints, sealants, wooden storage/display materials, cleaning compounds, furniture, and carpets.

Water and Fire

It is essential to protect works of art on paper from water damage. Even a minor water accident, such as one precipitated by a leaky pipe, can cause extensive and irreparable harm. Several precautions should be taken. Roof coverings and flashings over the storage space should be inspected regularly and repaired as needed. Gutters and drains should be cleaned frequently. Works of art should never be stored under water pipes, steam pipes, lavatories, mechanical air-conditioning equipment, or other sources of water. Art works should always be stored at least four inches or ten centimeters above the floor, never directly on the floor. Storage in basements or other areas where the possibility of flooding is great should be avoided. If paper *must* be stored in areas that are vulnerable to flooding, water-sensing alarms should be installed to ensure that water is quickly detected.

Damage caused by fire can be even more serious. If collections survive at all, they are likely to be charred, covered with soot, brittle from exposure to high heat, wet from water used to extinguish the fire, moldy, and to smell of smoke. Several fire-suppression methods are available, and at least one should be in operation in the storage space. Likewise, the storage space should be equipped with adequate fire detection wired directly to the local fire department or to another twenty-four-hour monitor. Opinion varies regarding the preferred type of detection and suppression for storage spaces containing works of art. An experienced fire safety engineer who is familiar with current developments in the field should be consulted. Also, all relevant publications of the National Fire Protection Agency should be reviewed.

Biological Agents

The primary biological agents that cause damage to works of art in storage are mold, rodents, and insects. Mold damage can pose a serious threat, especially if the storage space is located in a hot, humid climate or near a large body of water where humidity is high. Mold spores are ever-present in the environment, and the higher the temperature and relative humidity, the greater the risk of mold. Because mold damage can be devastating, measures should be taken to avoid its occurrence. The most important ones are sustaining levels of temperature and relative humidity that meet generally accepted preservation requirements; providing good circulation of air; and maintaining clean, clutter-free, storage areas. If a water-related emergency occurs, such as a flood or fire, wet items should be addressed and cared for immediately before any opportunity for mold growth develops.

Works of art on paper are appetizing to rodents and insects, and all possible steps should be taken to control them. As they are attracted by clutter and

food remains, storage areas should be kept clean at all times, and clutter, dust, and dirt should not be allowed to accumulate. Eating and drinking certainly should be prohibited in storage areas and, ideally, should not even be allowed in buildings where works of art are stored. If eating and drinking must be permitted, they should be restricted to a room designated for this purpose, which should be located as far away from the storage area as possible. Trash, especially that which contains food, should be removed from the building every day.

High temperature and, in particular, high relative humidity also encourage rodent and insect activity, and these should be controlled in storage areas. Since insects enter through windows, doors, and vents in storage areas, these should be kept closed as much as possible. Cracks or breaks in the building fabric are also points of entry, another reason for storage facilities to be well maintained. Grass and plantings should be cut back at least eighteen inches or forty-six centimeters from any building in which collections are stored. If possible, all items that enter the building, and certainly all that enter the storage area, should be checked for rodents and especially insects. This includes new items for the collection, items that are being returned after a loan, and all equipment, supplies, and packing materials. For monitoring purposes, the use of rodent and insect traps is recommended in storage areas.

Theft and Vandalism

Because of the high value of works of art on paper, storage spaces must be adequately protected from theft and vandalism. This requires securing the building in which the storage space is located as well as the space itself. A specialist in security systems should be consulted, as protection can range in complexity from simple locks to elaborate security systems. The building that contains the storage space should be well secured during hours when it is closed to the public. Good protection measures include perimeter intrusion alarms and internal motion detectors that are wired directly to the local police department or to another reliable twenty-four-hour monitoring agency. During working hours it is best to use only one building entrance and exit to be used by visitors and staff alike; all other doors should be alarmed so that any unauthorized use can be detected. Windows should be kept closed and locked. The distribution of building keys should be carefully limited, and keys to the storage area should be limited even further. A list of keyholders should be kept current, and staff members should be required to return keys when they leave the employ of the institution. Access to storage areas should be strictly limited, and only a few specific staff members should be given the authority to enter.

SELECTING STORAGE ENCLOSURES

Storage enclosures, mats, interleaving papers, folders, envelopes, and boxes, should be made from materials that meet preservation standards. The use of poor-quality materials causes irreparable visual and chemical damage. Discoloration from acidic window mats, often referred to as *mat burn*, disfigures prints and drawings and hastens their deterioration in the area where it occurs. Similar damage takes place when items are framed with poor-quality materials such as wood (e.g., pine slats) or with corrugated cardboard backings. These materials cause characteristic slat burns or striations in the work of art.[1] When mats become acidic, they also become brittle. Eventually they may be unable to support their own weight and may break, causing tears and creases. Storage boxes made from poor-quality materials can likewise deteriorate to the point that that they fall apart, threatening the safety of the items they are meant to protect. Nonarchival interleaving papers discolor the items they touch hastening chemical deterioration. The same is true for folders, envelopes, and portfolios made of inferior materials.

Chemical Stability

Much of the deterioration that works of art suffer is caused by acids in the papers that are used to enclose them. This deterioration is most noticeable as discoloration and embrittlement. Because acids can migrate from storage enclosures into their contents, it is essential for the storage enclosures to be made from acid-free materials. Storage materials must remain chemically stable to ensure that they do not form acids over time that can then be transferred to the items they contain. Certain common components of paper introduced during its manufacture can lead to the formation of acids, including lignin, ground wood, and alum-rosin sizing.[2] All storage materials should be free of these components. The board used for matting works of art on paper should be 100% cotton ragboard or an otherwise lignin-free chemically purified conservation mounting board. The board for boxes should also be lignin-free and chemically purified. All papers for interleaving sheets, folders, and envelopes must also meet these specifications. Adhesives and tapes for making mats, folders, and boxes must be chemically stable, non-staining, and free of damaging components.

It is vital to know *all* the components in storage materials. For example, even 100% ragboard can be, or become, acidic if it is sized with an unstable sizing agent[3] or wrapped with poor-quality paper. The presence of damaging substances, such as ground wood or alum, can be determined by using reagent stains. The reagents are available in testing kits from suppliers of storage materials, although these kits are sometimes difficult to obtain because of health and safety concerns. The individual reagents are available separately

from chemical supply houses. A paper conservator can advise on which reagents to obtain and how to use them.

Alkaline Reserves

Some paper-based storage materials contain a buffering agent, such as calcium carbonate, which has been added during manufacture. The buffer neutralizes acids as they form in or are absorbed by the storage materials. Suppliers of these materials should be able to provide information regarding the type and amount of the alkaline buffer used. Many papers and conservation mounting boards contain a reserve of 2% to 5% calcium carbonate. Buffered materials are appropriate for storing most kinds of works of art on paper; exceptions include those that contain dyes or pigments that are sensitive to high alkalinity, collages with wool or silk components, and certain types of photographs, such as cyanotypes and diazo reproductions.[4]

Molecular Traps

One relatively new type of storage material that meets all the specifications noted here incorporates molecular traps with an alkaline reserve. Because of its predominantly porous structure, a molecular trap, such as activated carbon or natural or synthetic zeolite, can capture and retain gases. Zeolites are microporous crystalline aluminosilicate compound structures that can trap molecules of gaseous pollutants. Zeolites, unlike activated carbon, can be fabricated to trap specific gases. This modification was developed to address the problem of gaseous pollutants that do not react with an alkaline reserve.[5] As yet, there is no reliable method of determining when products containing molecular traps no longer provide protection against gaseous pollutants.

pH

The acidity and alkalinity of paper and paper-based materials, including mat board and cardboard, is expressed by pH, a measurement of potential available hydrogen that is based on a logarithmic scale of zero through fourteen. Seven is the neutral point, with measurements under seven indicating acidic and over seven indicating alkaline conditions. Although the recommendation varies for what an ideal pH for storage enclosures should be, a pH of 7.0 through 8.5 is a good general range for works of art on paper. Photographic works of art require special consideration, however, and different types of photographs have different needs, which should be determined by consulting a photographic materials conservator.

There are several methods for measuring pH. The simplest is the use of a pH detector pencil or pen, which indicates the surface pH of the material being tested. A more specific pH reading can be obtained by using pH

indicator strips. The most accurate readings are those provided by pH meters. One should not rely solely on pH measurements when selecting storage materials, however. A pH reading above 7.0 does not necessarily mean that a material is of preservation quality. For example, it has been noted that newly manufactured wood pulp board can be alkaline, but it will soon become acidic.[6] Such variables make it important to identify all the components of storage materials, and to determine the processing of their components. This information should be considered along with the pH when selecting materials for storage enclosures.

Durability

Works of art on paper should be stored only in enclosures that are sufficiently durable to protect them. If enclosures are not sturdy, the items they contain may become distorted, creased, or torn, or the storage enclosure itself may become damaged or even fall apart. Needlessly strong storage enclosures may also present problems, adding the kind of unnecessary weight and bulk that can lead to handling and spatial difficulties.

ANSI Standards

The term *permanent* or *permanent durable* is sometimes used to describe materials that are chemically stable and durable. These terms are employed by the *American National Standard for Permanence of Paper for Publications and Documents in Libraries and Archives*, ANSI/NISO Z39.48-1992, approved by the American National Standards Institute and developed by the National Information Standards Organization. This standard establishes criteria for paper that will last for several hundred years under normal use and storage conditions. It is intended as a guide in selecting papers for use in publications and can serve as a guide in selecting papers for use as storage materials. Separate standards exist for storage enclosures for photographic works of art. The *American National Standard for Imaging Media—Photographic Processed Films, Plates and Papers—Filing Enclosures and Storage Containers*, ANSI IT9.2-1998, provides specifications for enclosures. Another standard that further specifies criteria for enclosures for photographs is the *American National Standard for Imaging Media—Photographic Activity Test*, ANSI IT9.16-1993. Storage enclosures for photographs should meet both standards.[7]

Plastics

Plastics vary greatly in chemical stability and should be used with caution. Some plastics are unstable chemically and produce byproducts as they deteriorate that accelerate the breakdown of paper. Others contain volatile plasticizers that can cause items in contact with them to stick to their surface and allow media to bleed.[8] Three types of plastic meet preservation standards. These are polypropylene, polyester, and polyethylene.[9] The first two

are commonly used for the storage of art on paper. The third usually is employed in storing photographs for historic or research purposes rather than those that are of artistic value.

Polypropylene is frequently used as a material for boxes and trays. Polyester film is used as an interleaving material to protect the surface of items, for folders, and to encapsulate single items. Only those polyesters that are free of plasticizers, ultraviolet inhibitors, dyes, and surface coatings should be used. Polyester film has an electrostatic charge that can lift loosely bound media from the surface of paper. For this reason it should not be used for items with media that are not firmly bound to paper, such as pastel, chalk, charcoal, and soft graphite pencil. Flaking inks and photographic images may also be adversely affected by static electricity, so polyester film should be used judiciously for items with these problems. For folders and encapsulation, polyester film can be sealed by using equipment that forms either an ultrasonic or heat-activated weld. If the equipment required for this welding is not available, the polyester can be sealed by using double-sided tape. Only tapes that meet preservation standards should be used; they minimize the emission of the damaging by-products produced as they deteriorate, and help to prevent the creeping or movement of the adhesive that can cause works of art to become adhered to it.

STANDARD-SIZED ENCLOSURES

In many institutions, works of art on paper are stored in standard-sized enclosures whenever possible. The use of standard sizes makes the most efficient use of space, minimizes wasting storage materials, saves time when selecting a size for a storage enclosure for a particular work of art, and is generally convenient.

For example, the decision of what size to use to mat an item is facilitated when the choice consists of only three or four standard sizes. Among other benefits, standardizing the selection process saves curatorial time. Cataloging and determining storage locations are simplified as well because location can be based on standard sizes. The board for matting works of art can be purchased in sizes that conform best to the standard sizes used in the institution, minimizing the waste of expensive mat board and reducing the time required to construct a mat. Good preservation practice specifies that all items stored in a box should be matted to the size of the box to prevent movement of the items within and the damage that can result from such movement. The use of standard sizes aids in this. In addition, boxes for the storage of matted items can be purchased in quantity when standard sizes are employed. Purchasing in quantity usually means obtaining a reduced

price per box. The boxes can be stacked on shelves with greater security when they are the same size, although, ideally, boxes should not be stacked more than two or three high. Shelf space also can be used with greater efficiency when standard-sized boxes are stored on shelves, especially if the sizes are chosen to fit the shelves, or when the shelves are adjustable and can be arranged to fit the boxes. These same advantages apply when other types of enclosures and storage furniture are used. Envelopes, folders, and portfolios can be produced in one of several standard sizes to fit into standard boxes or drawers. These practices not only provide convenience, but they promote the most efficient use of staff time, storage materials, and space.

Enclosures of all types are commercially available in many different standard sizes. For institutions that are still in the process of establishing standard sizes, care should be taken to base the selection on the nature of the use the collection receives, the sizes of the items in it, the dimensions of the furniture in which it will be stored, and the commercially available sizes of the storage materials and enclosures (mat board, boxes, folders, envelopes) that will house it. In many institutions, however, the selection of standard sizes is determined by historic precedent within the institution; standard sizes were selected long ago and are still in use at present. In certain cases, these standard sizes do not conform well to commercially available storage materials and furniture, yet changing them would be extremely difficult and prohibitively expensive. Those institutions that employ standard sizes which do not match commercially available sizes can have enclosures custom-made to the unique sizes of the institution.

TYPES OF ENCLOSURES

Several types of enclosure are suitable for storing works of art on paper. Selecting the best type of enclosure requires assessing the components of the work of art (media, substrate, backing); its format (size, shape); its condition (sturdy, fragile, acidic, brittle, torn); its use (exhibition, research); the availability of space for storage, and the institution's current financial constraints.[10]

Frames

The best way to store a work of art on paper is in a glazed frame that meets preservation standards. Just as frames are ideal for exhibition purposes because they allow items to be hung and displayed safely and presented aesthetically, they also provide excellent protection for them in storage. Works of art on paper should never be touched, and frames ensure this, providing the best protection from handling of any enclosure. Frames as

storage modules also furnish excellent protection from dirt and, to a limited extent, from pollution.[11] They are the preferred storage enclosure for works of art that are fragile either because of the media used in them or simply because of their general condition. Items with media that smudge, such as charcoal, pastel, and chalk, need complete protection from touching. Those that are weak, brittle, or otherwise fragile because of their deteriorated condition need special protection from flexing. These items should always be stored in a frame, and the frame should be stored flat on a shelf. Items that have frames of artistic or historic importance or otherwise have value because of their provenance should be stored in frames. This will prevent the works from being separated from the frames and the frames being lost. Likewise, important works that have frames especially designed or custom-constructed for them, or frames that they look especially well in, should be stored in them. The primary disadvantage of frame storage is that it takes up more space than is usually available. For this reason, most works of art on paper are stored in mats.

Mats

The traditional enclosure for storing prints and drawings in sound condition and with stable media is a mat. Mats provide good protection from the hazards of handling, present works of art attractively, allow them to be easily and fully examined, and take up relatively little storage space. Many institutions aspire to have all their works of art matted, except for those that are framed and oversized. Mats are usually constructed of two paper-based boards, a window mat and a backboard, which are fastened together along the top or along one vertical edge. The window mat is for viewing the image, while the backboard is for support and should be rigid enough to prevent the item from flexing. The opening should be large enough to permit viewing with the window mat in place, as lifting it risks damage to the item. The two boards should be the same size and should be larger than the item in order to protect its edges. For most works of art on paper, suitable mats can be made of a buffered, lignin-free board, such as 100% ragboard or conservation mounting board. These can be made in-house, custom-made commercially, or purchased in standard sizes from suppliers.

Interleaving Sheets

Often matted items have an interleaving or slip sheet placed between the window mat and the surface of the item to protect the item from dirt and abrasion. The sheet should cover the work of art completely but not extend beyond the mat, which causes the sheet to become dirty and tattered at the edges. Interleaving sheets that are transparent enough to see through have the advantage of reducing manipulation of the work of art. A variety of machine- and handmade papers are suitable for interleaving purposes. For

most works of art, a buffered, lignin-free paper is preferred. Care should be taken to select an interleaving material that does not react with an item's media. For example, a pH-neutral interleaving material is preferable when media are sensitive to high alkalinity. A smooth hard-surfaced material such as acid-free glassine is usually recommended for interleaving a pastel, as a rougher-surfaced buffered tissue may smear the media. Because there is some concern that glassine, even the acid-free variety, will become acidic relatively quickly over time, only acid-free glassine should be selected, and its acidity should be monitored. A corner of the glassine interleaving sheet should be removed and tested, and the sheet should be replaced as soon as it becomes acidic. Non-buffered tissues should also be monitored for acidity and replaced as needed.[12] Polyester film is sometimes used as an interleaving material because it is transparent and chemically stable. It can scratch both items and users, however, and its electrostatic charge also attracts dust and dirt that can be transferred to items and can cause damage to those with fragile media.[13] It therefore should be used only when the handling of items is carefully controlled and when media are firmly bound to the surface of the paper. Interleaving materials are available commercially in several standard-sized sheets or in large sheets or rolls that can be cut in-house to the exact size.

Folders

If matting is prohibitively expensive or takes up too much storage space, items can be placed in sturdy paper folders instead. Paper suitable for folders comes in a variety of weights and thicknesses; for most items, it should be buffered and lignin-free. Folders can be made easily in-house or purchased commercially in standard or custom sizes. Only one item should be stored in a folder. The folder should be made of a paper that is rigid enough to provide adequate support for the item, and it should be slightly larger than the item in order to protect the edges from becoming dirty and torn. Folders can be constructed with flaps to further protect the edges of the item. A mounting board of suitable quality can be inserted in the folder to provide additional support if needed. When media on the item are delicate, the item can first be placed in a folder of buffered tissue or acid-free glassine and then in the paper folder. Alternatively, an interleaving sheet can be placed over the surface of the item.

Envelopes

An alternative to a folder is an envelope, less desirable than a folder because of the additional handling it requires and the consequent danger of damaging the work of art as it is slipped in or taken out. This hazard can be reduced slightly by using an envelope that is substantially larger than the item and by first wrapping the item in buffered tissue or acid-free glassine.

Envelopes should be used only for relatively sturdy items. Those made of buffered, lignin-free paper are suitable for the storage of most works of art on paper. They are commercially available in a variety of standard sizes.

Boxes

The preferred method of storing matted items is to place them in sturdy heavy-walled boxes. The boxes should be strong enough to support the weight of the items they contain without buckling and yet be as light as possible so they do not add unnecessary weight and bulk. Materials used in the construction of boxes should meet preservation standards (to the extent that this is possible), and all materials in direct contact with items inside the box should be acid-free, lignin-free, and buffered. Boxes should open easily to minimize jarring of items inside and should close snugly enough to keep out dust and stay securely closed until opened intentionally. Boxes range from expensive cloth-covered and lined varieties to less costly self-assembly types of uncovered conservation mounting board. Solander boxes, designed in the eighteenth century by Dr. Daniel Charles Solander, a Keeper at the British Museum, have traditionally been used for the storage of art on paper. One-piece drop-spine or clamshell boxes also work well, as do two-piece print storage boxes. These styles of boxes are available commercially in standard sizes and can be custom made in specific sizes. All items stored in boxes should be matted to the size of the box, not the item. This will prevent movement of the matted items in the box and the damage that may result from this movement. Boxes should be stored flat on shelves. They should be kept full to minimize any movement of the items within them. For this reason they also should be shallow enough so they will not be too heavy to handle safely when they are full.

Items that are stored in folders or envelopes can also be stored in boxes. Like mats, all folders and envelopes that are housed in a box should be the size of the box. The number of items stored in a box should be determined by their weight. The box should not be too heavy for any person of average strength to handle comfortably and safely.

Alternatives

If boxes are too expensive to use for all matted items, some can be stacked unboxed on shelves. This practice is far from ideal because both the mats and the items they contain can become dusty, dirty, and abraded. To promote safe stacking, all mats in a stack should be the same size, and interleaving sheets should always be used. Likewise, if necessary, folders and envelopes can be stacked on shelves and should be a standard size when stacked. Shelves that slide forward are best for items that are not boxed as they facilitate the removal of items. Sliding shelves are very expensive, however.

An alternative is to supplement stable shelves with trays made from preservation-quality corrugated plastic sheets; the trays are used to slide the items the shelves contain forward for easy and safe access. These may not be available commercially but can be constructed in-house to the same height, width, and depth dimensions of each shelf. The walls of the tray, which should be equal in height to the distance between the shelves, are riveted to the left, right, and back sides of the tray, leaving the front side of the tray exposed so the contents of the shelf can be seen.

If items in mats, folders, or envelopes are too large to be stored in a box, they should be stored in the drawers of cabinets such as map cases, blueprint cabinets, or flat print files. Folders should be made to the size of the drawer (not the item), and all items should be placed in a drawer-sized folder and then in the drawer. This will prevent smaller items from being pushed to the back of the drawer and from moving as the drawer is opened and closed. If drawers are not available, large items can be stored on shelves large enough to accommodate their size.

Portfolios

Portfolios are useful for the storage of items that are particularly fragile, are heavier or thicker than most other items, or are oversized. Four-flap portfolios provide the best protection, covering all edges of the item. If possible, these should be of one-piece construction, without tapes or adhesives that could react with the item. Portfolios can be stored on shelves or in drawers. If stored in drawers, they should be made to the size of the drawer or half the drawer, so that two portfolios can fit in the drawer with minimal movement. Portfolios are available commercially in standard sizes, although the selection is not as great as for other enclosures. Having them custom made in-house or commercially is probably a better option.

Polyester Film Folders and Encapsulations

Polyester film is especially useful for the storage of weak, brittle, or torn items. It can be used as a folder, with one sheet of polyester film folded in half and creased. Alternatively, two sheets can be welded or taped together along one edge. If it is unnecessary for an item to be removed from the polyester film, or if it should not be removed because of its fragility, it can be encapsulated between two sheets of the film, with the film welded or taped along all four edges. Research demonstrates that acidic papers may age much faster after encapsulation, and that leaving an air space at the corners of an encapsulation does not slow this aging, as was once speculated. Certain items might be protected from this aging by alkalization (deacidification) prior to encapsulation. Alkalization should be undertaken only by a qualified person. If alkalization is not appropriate or feasible, encapsulation may

still be desirable to protect items that are very fragile or heavily used. In such a case, including a sheet of buffered paper behind the item can slow the rate of deterioration. This practice is only appropriate for items that do not need to be seen on the verso and that do not contain pH-sensitive colors.

Because of the electrostatic charge of polyester which will attract dust, folders and encapsulations made of this material should be stored in a box or drawer to keep them clean. In addition, polyester film scratches easily. If such scratches would present a visual problem, the polyester enclosure should be placed in a paper folder before it is stored in a box or drawer. Items with images that are not firmly bound, such as works of art in pastel, charcoal, chalk, or soft graphite, should not be stored in polyester film because of its static charge.

SELECTING STORAGE FURNITURE

The selection of furniture for storing works of art on paper requires careful investigation. Many of the currently available furniture choices contain materials that produce by-products that contribute to the deterioration of the collections they house. Opinion on what constitutes acceptable storage furniture is changing rapidly. Before decisions with far-reaching impact are made, a preservation professional should be consulted for the most up-to-date information. Making the right choice will add immeasurably to the useful life of collections.

Baked Enamel

For some years, only baked enamel furniture was recommended for storage. Constructed of steel with a baked enamel coating, this furniture was thought to be made of chemically stable materials. Because it is readily available, competitively priced, strong, and durable, it has been a particularly attractive choice. Concern has been expressed, however, that the baked enamel coating may give off formaldehyde and other volatiles harmful to collections if it has not been properly baked (not long enough at high enough temperatures). The matter is especially serious when collections are stored on shelves in an area that is enclosed or has poor air circulation, or are stored in closed furniture such as drawers and cabinets with solid doors. Because of this concern about off-gassing, baked enamel furniture is no longer widely recommended unless it has been properly baked, and to ensure that it has, the furniture must be tested. Testing should comply with American Society of Testing Materials (ASTM) E-595. The process requires the use of sophisticated analytical equipment. Furniture can be less conclusively tested in-house with the organic solvent methyl ethyl ketone (MEK).[11]

If this crude test, commonly referred to as the MEK rub test, indicates that the enamel coating may not be properly baked, testing by a professional testing service should be considered to conclusively determine if the furniture is off-gassing.

Powder Coatings

Steel storage furniture with various powder coatings appears to avoid the off-gassing problems associated with baked enamel. In this type of manufacture, powder coatings of finely divided, synthetic polymer materials are fused onto the steel. Testing done thus far indicates that the coatings are chemically stable, present minimum threat of volatile evocation, and so are safe for the storage of valuable collections. Nevertheless, conducting the MEK rub test in an inconspicuous area where the steel is the heaviest gauge will confirm that the coating is properly cured and that off-gassing is not a concern.

Anodized Aluminum

Anodized aluminum storage furniture is another option. This uncoated metal is extremely strong yet light in weight. The metal itself is reported to be non-reactive and, since it has no coating, off-gassing is not a concern. Anodized aluminum is considered by many to be the best choice, especially for highly sensitive materials, but it tends to be the most expensive.

Chrome-Plated Steel

Open chrome-plated steel shelving, made of heavy-gauge, chrome-plated steel wire, is a storage choice suitable for boxed materials. The shelving is durable, and the open-wire framework is light in weight and provides good air circulation. Since the wires can leave permanent marks on items that are not protected, however, items should be boxed or the shelves should be lined.

Wood

Traditionally, storage furniture made of wood has been popular for reasons of aesthetics, economy, and ease of construction. Harmful acids and other substances, however, are emitted by wood, wood composites, and certain sealants and adhesives. Although the levels of emissions are highest when the furniture is new, in most cases, volatiles are present for the life of the materials and, to avoid potential damage to collections, storage furniture made of wood or wood products should not be used. If wood must be used, precautions are necessary. Certain woods and wood composites are more potentially damaging than others. For example, oak, which has been employed extensively for storage furniture, is considered the wood with the most volatile acidity and should not be used. Further,

many wood composites that are advertised as formaldehyde-free may contain potentially damaging acids or other aldehydes. They should be tested to determine their safety for use.[15] These composites also may contain potentially damaging acids or other aldehydes. Current information should be obtained from a preservation professional before selecting new furniture made of wood or a wood product so that the least damaging wood can be chosen.

Coatings for Wood

For wooden storage furniture that is already in use, safeguards should be taken. All wood should be sealed. While some sealants are better than others at blocking damaging substances, no coating or sealant will completely block the emission of acids and harmful volatiles for prolonged periods of time, but it can be useful for short-term exposure. Great care must be taken in selecting a sealant to ensure that the one chosen forms the most effective barrier and does not itself emit harmful substances. The most readily available sealant that is recommended at this time is a moisture-borne polyurethane. It should be noted that while oil-modified polyurethanes are the most common, these—oil-based paints and other products that contain oil or alkyd resins—should be avoided; only moisture-borne polyurethanes are recommended. Unfortunately, not all moisture-borne polyurethanes on the market are safe for use. Because these urethanes do not entirely prevent the escape of volatiles, choosing low-emission wood products is of great importance. Moreover, formulations often change without notice. For these reasons, the polyurethane selected should be tested prior to use to guarantee its acceptability. Contact a preservation professional for brand names of moisture-borne polyurethanes that are currently being recommended, and begin testing with these.

If the natural appearance of the wood does not have to be retained, paints can also be used to seal wood. Oil-based paints and stains should not be used because of the potentially damaging effects of acids in the drying oils. Two-part epoxy paints form an excellent barrier, but these are difficult to use. Latex and acrylic paints form a less effective barrier but are easier to use. In general, all coatings should be tested prior to use. Consult a preservation professional for current information before making a decision. After furniture is sealed, it should be allowed to air for three to four weeks. Because of the toxicity of various components of most sealants, the sealants should be used with caution and appropriate safety measures observed.

Additional Barriers

In addition to sealing wood, shelves and drawers should be lined with an effective barrier material. Barriers that are recommended at present in-

clude inert metallic laminates, polychlorotrifluoroethylene (PCTFE) high-barrier films, sheet aluminum, glass, polymethyl methacrylate sheeting, or a combination of these.[16] Note that the printing inks found on some of these barrier materials may be corrosive.[17] Contact the manufacturer for information on the printing inks or to request products without printing. If these barriers do not provide an appropriate surface for the storage of materials, 100% ragboard or other conservation mounting board can be used in addition. These boards, however, should not be used by themselves because they do not provide a sufficient barrier. They should be used only in conjunction with the other barrier materials noted here.

Construction Features

Regardless of the construction material chosen, storage furniture should have a smooth non-abrasive finish. If steel furniture is painted or coated, the finish should be resistant to chipping because chips will leave steel exposed and susceptible to rust. The furniture should be free of sharp edges and protrusions; exposed nuts and bolts are particularly hazardous. The furniture should be strong enough so that it will not bend or warp when filled. To protect collections from water damage in the event of a flood, the lowest storage area within it should be at least four to six inches or ten to fifteen centimeters above the floor.

When security and protection from dust are special concerns, cabinets with doors are often preferred. These are available with shelves or drawers. The use of piano hinges for the attachment of the doors is advisable if opening the doors flat will facilitate safe removal of items from the cabinet. These cabinets are usually made of steel. It has been noted that condensation can be a problem in closed steel cabinets when the relative humidity where the cabinets are located fluctuates.[18] Condensation can promote rusting and mold growth in cabinets. For this reason, conditions in closed cabinets should be monitored. This is most easily accomplished by the use of dial hygrometers or paper-based humidity indicator cards. If possible, the use of closed steel cabinets should be avoided unless the cabinets are well ventilated or the relative humidity is closely controlled and monitored.[19]

TYPES OF STORAGE FURNITURE

Several types of furniture are available for the storage of art on paper. The choice is based on the types, sizes, and quantities of materials that need to be stored.[20] In general, the furniture selected should be as flexible and adaptable as possible to accommodate changing needs. Styles that stack or are adjustable are preferable and, unless otherwise noted, all are available commercially from suppliers of museum, library, and office furniture.

Shelves

Shelving is one of the most frequently used types of storage furniture. Care should be taken to select shelving that is strong enough that it will not sag from the weight of the items stored on it. It should be easily adjustable so that the distance between shelves can be changed to suit the sizes of a variety of enclosures, making maximum use of storage space. Shelving units that fit together so that shelves can be placed side-by-side or end-to-end to accommodate oversized items provide the most flexibility. The shelves should fit snugly in place so they do not move when items are placed on or removed from them. Shelving units should be bolted to the floor so they will not wobble or topple when collections are housed on them. They may require additional reinforcement by attachment to the walls and ceiling as well. Shelf uprights and supports should never obstruct the removal and replacement of items, and cross-bracing should be kept to a minimum to allow easy storage of oversized items. As noted earlier, the use of in-house constructed trays can slide shelved items back and forth for safe access.

Drawers

Drawers are another frequently used type of storage furniture. They should be of sturdy construction so they will not buckle from the weight of their contents when full or otherwise become difficult to open and close. Drawers should have ball bearings rather than slide in grooves because these will allow them to open and close more smoothly, causing less vibration to items and eliminating the risk that the drawers will fall out of the grooves and become stuck. As added protection from jarring and vibration, drawers can be lined with acid-free foam core for cushioning. They should be equipped with stops to prevent them from accidentally coming out of the cabinet. The drawers should be no more than two inches or five centimeters deep and less if possible; the deeper the drawer the greater the weight on the items in it, and the greater the possible stress on them when they are removed. Very thin drawers should be selected for items that cannot be stacked. All drawers should have dust covers or rear hoods to prevent the items they contain from being damaged at the back of the drawer.

Bins

Framed works of art on paper have special storage needs. As noted earlier, framed items that are fragile because of their media, their condition, or the nature of their frames should be stored flat on shelves. Other alternatives are available for framed items that are stable. One is to store them in bins. Framed items should be placed in bins vertically, standing on edge. They should be positioned face-to-face and back-to-back, and separated by pieces of sturdy acid-free corrugated board or foam core that are slightly larger than the items they separate. Acid-free cardboard sleeves should be made

for items in ornate frames. Ideally, bins should not house more than three or four framed items. Bins should be large enough to accommodate items easily. Using bins that are too small may lead to damage of the frames or to broken glass.[21] They should also be deep enough so that items do not extend out of them into walkways. Likewise, small items should not be stored in deep bins, as the items can be difficult to retrieve and the space at the back will be wasted. Having bins of different heights and depths avoids these problems. The bottoms of bins should be covered with carpet to protect the edge of the frames on which the items are standing. Clearly marked labels affixed to the exposed sides of the frames will provide ready identification and eliminate the need for haphazard rummaging to find a specific item. Bottoms of bins should be several inches above floor level for cleanliness as well as for protection from water in case of flood.

Screens

Another alternative for the storage of framed items is to hang them on wire screens or racks, stationary or movable. Some institutions have had success sliding screens on roller blade wheels. Screens work particularly well for the storage of three-dimensional items, boxes made of polymethyl methacrylate sheeting, and larger items. They also work well for odd-sized items, which can be hung wherever they fit to use all available space; such items tend to take up greater space in a bin. Fragile works, such as pastel, charcoal, and chalk drawings, should not be stored on screens because of the vibrations they will experience, especially from sliding screens.[22] Cover fronts to avoid light but with the artist's name or the work's account number clearly written.

High-Density Storage Systems

Many institutions with space limitations use high-density storage systems, often referred to as compact or movable shelving. These systems minimize the amount of space needed by compacting ranges of shelves or cabinets of drawers tightly together. The ranges slide along tracks so they can be moved apart to retrieve items on a particular range and then be moved back together again. By eliminating most of the distance between the ranges, more ranges can be fitted into a given area and overall spatial requirements are substantially reduced. These storage systems can be operated automatically by pushing a button to separate the ranges or mechanically by using a hand crank to separate them. Mechanical systems are usually selected for the storage of art on paper, because it is assumed they can be operated smoothly, avoiding jolts that can jar items, and require relatively little maintenance. It should be noted, however, that moving systems such as these, even the hand-operated ones, can be damaging to works of art because of the vibrations to which they subject items. Further, items can be jostled off shelves, causing

additional damage. If a high-density storage system must be used, a design should be chosen that minimizes these hazards for the types of items that are stored in them. To avoid having the items on opposite shelves collide with one another when the ranges are closed, it is crucial that items do not extend beyond the edge of their shelves. When installing high-density systems, enough overall space should be allowed to ensure that sufficiently wide aisles can be opened between the ranges for the safe removal of items, particularly oversized ones, from shelves and drawers. Floor loading is a serious concern and should be taken into account if many heavy items are stored in a confined space. Weight estimates need to include floor treatment, furniture tracks and fittings, and shelf and drawer loads as well as the furniture. A structural engineer should be consulted. Fire detection and suppression are additional concerns. A space of a few inches always should be left between the ranges so that a fire between them can be detected and quickly suppressed. Leaving a small space also enhances air circulation, avoiding the buildup of pockets of damp or stagnant air.

OVERSIZED STORAGE

Because oversized works of art on paper are particularly vulnerable to damage due to their size and weight, it is especially important to provide adequate storage for these items. Flat storage is best, and the use of cabinets with shallow drawers is preferable. Selecting cabinets for oversized items requires special attention to the functioning of the drawers. They should be lightweight and should open and close easily and smoothly without binding. They should also be suitable for the viewing of items within them if the items are too large and cumbersome to be removed for a brief examination. Drawers for extra-oversized cabinets can be specially made of lightweight honeycomb aluminum panels if a particularly large size is required. A similar system that works well for oversized items is flat tray storage; the trays slide in and out of a cabinet so the item can be transported as well as stored and examined on the tray. For the best strength to weight ratio, the frame of the tray is made of aluminum and the bottom of fabric. Cabinets with drawers or trays for oversized items are available from commercial suppliers in standard or custom sizes. Cabinets with extra-oversized drawers made of honeycomb aluminum panels are also available commercially and tend to be very expensive. If it is not possible to store oversized items in cabinets with drawers or trays, they can be stored in large covered boxes of acceptable quality, which are then stored on shelves. Handling these boxes can be awkward, and two people are usually required to lift and move them safely.[21] Boxes are available commercially in standard or custom sizes. If storage in boxes is not possible, items can be placed in folders and stored on oversized shelving.

Regardless of whether oversized items are stored in a drawer, tray, or box, they should be placed in a folder first. The folders should be sturdy and cut to fit the size of the drawer, tray, or box. Folders of this size are preferable to smaller ones, which tend to get jammed at the back of drawers and trays or to shift position as drawers open and close or as trays and boxes are moved. As a rule, lignin-free buffered folders should be used. Items with media that are sensitive to high alkalinity, however, should not be stored in alkaline folders; lignin-free neutral folders should be used for these. Ideally, only one item should be placed in a folder, although more than one may be stored in a folder if necessary. If several items are placed in a single folder, they should be interleaved with acid-free paper, especially if the items have colors or if some items are more acidic than the others.

A variety of styles of folder are available for the storage of oversized items, in addition to the standard one that consists of one piece of rigid paper folded in half or two pieces held together with a strip of cloth tape. One style that is particularly useful is a rigid paper folder with a sheet of polyester film inside the folder that covers the front surface of the item and is attached to the folder along the opening edge. This style holds the item in the folder and protects its surface while allowing it to be seen when the cover is lifted. Another useful style is made from a lightweight conservation mounting board with a polyester film cover. This style is more rigid than others and provides more support for particularly brittle oversized materials.[24] These are available commercially or can be produced in-house. An alternative to the use of folders is encapsulation in polyester film. This method is particularly suitable for very brittle items. Because the polyester film scratches easily, encapsulated items should be placed in a paper folder if potential scratches present a visual problem.

There is some discussion about whether folders for oversized items should go in drawers, trays, and boxes with the fold at the front or the back. Putting the fold at the front encourages removal of the entire folder before the work of art is taken out of it. It also means that the work of art may slide out as the folder is removed. This can be avoided by putting the fold at the back.[25] The decision of which method is better should be based on what causes the least risk in a given situation.

Adequate surface space should be available where oversized materials are stored so they can be safely set down as they are removed from, or returned to, drawers, trays, boxes, and shelves. This space can be a table or the top surface of storage cabinets, but it should be kept clear at all times to ensure the safe removal and inspection of items. Aisles and walkways should be wide enough to move items safely and should be kept clear at all times.

When flat storage is not possible, oversized items can be rolled if they are not brittle or fragile. This method of storage should be used for works of art on paper only in instances of extreme necessity, however, or as a temporary measure. Flexing flat paper items can be damaging. It is important to make sure that the items and their media are not too brittle, fragile, or thick to sustain rolling and unrolling. Ideally items should be rolled individually; if necessary, they can be rolled in groups of no more than four to six similar-sized items, with the exact number depending on the size and weight of the paper. Items should be rolled face-out on a tube for support, and care should be taken to roll them with proper tension so they are rolled neither too tightly nor too loosely. A tube several inches longer than the largest item being rolled, and at least four inches in diameter (larger diameters are preferable), should be used. The tube should be made of low-lignin, pH-neutral, or buffered materials. If it is not, it should be wrapped in neutral or buffered paper or polyester film. Alternatively, the items can be placed in a folder of five-mil polyester film, cut several inches larger in both dimensions than the largest item being rolled. The item or items may then be rolled face out onto the tube. If a polyester film folder is used, it should be rolled so that the fold is parallel with the length of the tube. The rolled items and tube should then be wrapped on the outside with neutral or buffered paper or polyester film for protection from dirt and abrasion in storage. The wrapped roll should be loosely tied with flat linen, cotton, or polyester tape. If desired, this assembly may be stored inside a larger tube for added protection. Tubes should be stored horizontally. They can be stored on shelves if the shelving is large enough to accommodate them without their extending beyond the edge of the shelf. Alternatively, tubes can be mounted on walls by inserting a pole in the tube and resting the ends of the pole on brackets mounted to the wall.

A few words of warning about oversized artworks that are mounted on cardboard: special care must be given to the storage of these items. This board is often acidic and extremely brittle. Embrittlement of the board can endanger the work of art because the cardboard may break in storage or during handling, damaging the item. Such works of art must be carefully stored, sometimes in specially made enclosures that provide adequate overall support. These items should be handled with great care, and must be fully supported at all times.

ROUTINE HANDLING

Much of the damage to which works of art on paper are subjected is caused by the people who move the items from one location to another, or by those who use the items for study purposes. For this reason, it is vital to establish specific procedures for handling items and to ensure that they are strictly observed.

Anyone who handles an item should first wash his or her hands. Body oils leave disfiguring fingerprints on paper that are difficult to remove. The grime transferred from hands to a work of art mars the item visually and can cause abrasion to the surface of the paper and damage to the image. In general, an item should not be touched any more than necessary. It should be handled by using its storage enclosure. If it must be turned over, for example, this should be accomplished by handling only its mat or folder. If an item does not have its own storage enclosure, an acid-free paper folder can be provided. If the item itself must be handled, it should be held at the edges, touching no more of it than necessary and avoiding the image if possible. Two hands should be used. If an item is heavy, oversized, or otherwise difficult to maneuver, it should be handled by two people.

When an item must be moved from one location to another, it should be well supported. A rigid support larger than the item, made of acid-free corrugated board or similar material, always should be used under it. These supports or carrying cards can be cut to the standard sizes of the storage drawers, mats, and other enclosures used in the institution. If carts are used, they should be specifically designed for the transport of items: easy to maneuver and provided with protective rails and bumpers on the corners. The center of gravity of the loaded cart should be low to help stabilize it. Carts for transporting loose items should contain shelves with a rim around their edge to prevent items from sliding off. For transporting boxed items, carts with rimless shelves may be preferable. Framed items are best moved in carts constructed like bins on wheels, with the opening at the top. Works of art should be lowered into the cart and positioned front-to-front and back-to-back. Acid-free corrugated board or foam core dividers should be placed between the frames to protect them from abrasion, and the bottom of the bin should be carpeted to protect the edge of the frame on which the item stands. The bin should be divided into two or three compartments to limit the number of items in one compartment, permitting the safe transport of items of different sizes at the same time. Some institutions have carts custom built to accommodate the standard sizes used in the institution or to fit into special conveyances, such as dumbwaiters. Items being moved should never extend beyond the edges of the cart, and all walkways should be clear to prevent collisions.

Works of art on paper are particularly vulnerable to damage when they are being studied by visitors who may not have experience in proper handling procedures. Such visitors can include distinguished professionals and artists. Rules of procedure for all visitors should be established, clearly defined, and uniformly enforced. Many institutions give a written copy of these rules to visitors and ask them to sign an agreement to abide by them. The rules should be posted in the study room as a constant reminder to visitors and staff alike of the importance of careful handling.

Coats, briefcases, book bags, backpacks, umbrellas and other extraneous articles should be checked at the front door of the institution and never brought into the study room. Lockers or other secure storage should be provided for these. Only research materials should be allowed in the study room, and these should be limited in quantity. Only pencils should be used; pens and other types of writing or sketching materials should not be allowed. Food, beverages, chewing gum, and candy should not be permitted.

All visitors should be requested to sign a log book upon arrival at the study room and to wash their hands prior to being shown works of art on paper. They should be instructed in the best way to view and handle works of art, and a staff member should demonstrate. Visitors should work at a clean uncluttered table. They should not touch an art work or point toward it with a pencil. If the work of art is matted and stored in a box, it should be removed from the box in the manner determined by the institution. If the art work has an interleaving sheet, the mat should be opened from a lower corner and the sheet carefully lifted and removed. For viewing, the work of art should be placed on a cleared table or on an easel. If an easel is not used, the art work should be tilted upward, using both hands to hold the mat. This practice prevents the visitor from standing over and looking directly down on an unprotected item, inadvertently causing damage with hanging jewelry, neckties, or eyeglasses. At no time should works of art protrude over the edge of the table. Visitors should not be permitted to lift works of art to see the back. If the back must be examined, a staff member should be asked for assistance. When finished viewing the art work, the visitor should replace the interleaving sheet, making sure it is centered and smooth.[26] It should then be returned to the box in the manner determined by the institution. Works of art in other types of enclosures should be handled as specified by a staff member. Oversized works of art on paper should be handled only by a staff member.

FINALLY...

All institutions face the deterioration of works of art on paper. Employing professional conservation treatment as the primary means to rectify the problem is unrealistic, for the number of experienced professional conservators is limited and the financial resources required to retain them are greater than are available. Preventive care, however, is a realistic goal. The proper storage and handling of works of art on paper is easily accomplished and *relatively* inexpensive; several of the measures described here cost little or nothing. Following these guidelines is a practical, cost-effective way to contribute to the preservation of these valuable items.

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Sherelyn Ogden received an M.A. from the Graduate Library School at the University of Chicago and was trained in library and archives conservation at the Newberry Library in Chicago. She has twenty eight years experience as a practicing conservator, consultant, and teacher. She held the positions of Director of Book Conservation at the Northeast Document Conservation Center in Andover, MA and Director of Field Services at the Upper Midwest Conservation Association in Minneapolis, MN. She currently serves as the Head of Conservation at the Minnesota Historical Society in Saint Paul, MN. She may be contacted at the Conservation Department, Minnesota Historical Society, 345 Kellogg Boulevard West, Saint Paul, MN 55102-1906; e-mail at sherelyn.ogden@mnhs.org; or phone at 651-205-4661.

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NOTES

[1] Dianne van der Reyden, "Paper Documents," in *Storage of Natural History Collections: A Preventive Conservation Approach* (Iowa City: Society for the Preservation of Natural History Collections, 1995), 333.

[2] Karen Motylewski, "Choosing Archival-Quality Storage Enclosures for Books and Paper," in *Preservation of Library and Archival Materials: A Manual* (Washington, DC and Andover, MA: American Association of Museums and Northeast Document Conservation Center, 1994), 136.

[3] Margaret Holben Ellis, *The Care of Prints and Drawings* (Walnut Creek, CA: Altamira Press, 1995), 110.

[4] Nancy Carlson Schrock and Gisela Noak, *Archival Storage of Paper* (Syracuse, NY: Gaylord Bros., 1997), 2.

[5] Conservation Resources, *Conservation Resources General Catalog 1997/98* (Cowley, Oxfordshire: Conservation Resources, 1997), vi; Siegfried Rempel, "Zeolite Molecular Traps and their Use in Preventive Conservation," *WAAC Newsletter* 18, no. 1 (1996): 13.

[6] Ellis, *Care of Prints and Drawings*, 112.

[7] Gary Albright, "Storage Enclosures for Photographic Materials," in *Preservation of Library and Archival Materials: A Manual* (Washington, DC and Andover, MA: American Association of Museums and Northeast Document Conservation Center, 1994), 163.

[8] van der Reyden, "Paper Documents," 333.

[9] Schrock and Noak, *Archival Storage of Paper*, 3.

[10] van der Reyden, "Paper Documents," 337-338.

[11] Ellis, *Care of Prints and Drawings*, 146.

[12] Ibid., 151.

[13] Ibid.

[14] Saturate a cloth with methyl ethyl ketone (MEK) and rub it vigorously over a small inconspicuous area of the furniture to be tested. If the furniture is dark, use a light-colored cloth; if it is light, use a dark cloth. Rub the cloth over the

furniture backward and forward thirty times in each direction. The finish on the furniture may soften, take on a moist look, or discolor slightly. This is not a concern. Look at the cloth to see how much, if any, paint has been removed. Judgment must be used. Minimal or slight discoloration on a cloth is a reasonable assurance that the coating is properly baked. Medium to heavy discoloration indicates that the coating may not be properly baked and may need to be tested further. Please note that MEK is toxic. It must be used in a well ventilated area, and appropriate protective measures must be taken (B.W. Golden, Vice President, Engineering, Interior Steel Equipment Co., Cleveland, Ohio).

[15] This procedure is used for testing wood products, sealants, and a variety of other materials. If you are testing wood or other material, place a sample of the material in a glass jar. If you are testing a sealant, coat a clean glass slide with the sealant you want to test, and place the coated slide in a glass jar. Also place in the jar a piece of cleaned and degreased lead, silver, and iron. Prepare these metal pieces by rubbing the metal pieces with 600-grit sandpaper or steel wool and then wiping them with acetone or alcohol. Next dampen a piece of cotton with deionized water and place it in the jar with the metal pieces and wood sample or glass slide. Place the dampened cotton in a small glass beaker or glass vial in the jar so that it is not in direct contact with the metal pieces and glass slide. Cover the jar with two thicknesses of aluminum foil and secure the foil tightly with brass or other wire.

Prepare a second jar exactly the same way as the first but without the wood sample or coated glass slide. This jar will serve as a control. Place both jars in an oven at 60°C for three weeks or on a window sill for as long as possible. Watch for changes in the appearance of the metals. Looking under magnification will be helpful. Changes will probably occur in both the test samples and the control samples. If the changes in the test samples differ from those in the control samples, unacceptable substances are probably present. In the testing of wood composites, it is impossible to determine if the reaction is caused by the wood or by the adhesives in the composite. The wood or sealant should be discarded and another tested (Pamela Hatchfield, Conservator, Objects Conservation and Scientific Research, Museum of Fine Arts, Boston, MA).

[16] Pamela Hatchfield, "Choosing Materials for Museum Storage," in *Storage of Natural History Collections: Basic Concepts* (Pittsburgh, PA: Society for the Preservation of Natural History Collections, 1994), 7.

[17] Ibid., 5-6.

[18] Ellis, *Care of Prints and Drawings*, 148.

[19] Ibid., 148-149.

[20] van der Reyden, "Paper Documents," 340.

[21] Ellis, *Care of Prints and Drawings*, 147.

[22] Ibid.

[23] Ibid., 154.

[24] Mary Todd Glaser, "Storage Solutions for Oversized Paper Artifacts," in *Preservation of Library and Archival Materials: A Manual* (Washington, DC and Andover, MA: American Association of Museums and Northeast Document Conservation Center, 1994), 155-156.

[25] Ellis, *Care of Prints and Drawings*, 154; Glaser, "Storage Solutions for Oversized Paper Artifacts," 155.

[26] Ellis, *Care of Prints and Drawings*, 155.

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